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Design, Construction and Test of Small-Diameter Drift Tube Chambers for the Phase-1 Upgrade of the ATLAS Muon Spectrometer

The ATLAS muon spectrometer comprises an efficient muon trigger system and high muon momentum resolution up to the TeV scale. In the regions at both ends of the inner barrel layer of the muon spectrometer the trigger coverage in combination with the endcap muon spectrometer is limited. In order to improve the muon trigger capabilities at higher luminosities, additional resistive plate chambers (RPCs) will be installed in these regions in the next long shutdown of the LHC in 2019-2020 (Phase-1 upgrade). Given very tight spatial constraints, the present muon drift tube (MDT) chambers will be replaced by an integrated system of thin-gap RPCs and small-diameter muon drift tube (sMDT) chambers. Due to their 8 times higher background rate capabilites, the new sMDT cham- bers are also suitable precision muon tracking detectors at future hadron colliders. A comprehensive overview of the production of the sMDT chambers will be given, covering the construction of the drift tubes, the evaluation of the wire positioning accuracy required to be better than 20µm, deformation measurements using optical alignment systems and the installation and test of the gas distribution system and electronics. The evaluation of the sMDT chamber geometry with a coordinate measuring machine yields a wire positioning accuracy of better than 10µm for the 1.5×1.5 m2 chambers with up to 744 drift tubes. Test results of sMDT chambers with cosmic rays and in a high-energy muon beam at CERN are presented.

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